CLAIMS

1. A laser, comprising:

a medium doped with first ions that emit light at a laser wavelength as a result of the transition of electron energy from an upper energy level manifold to a lower energy level manifold;

a first pumplight aligned to couple energy into said medium at a first wavelength that excites a first portion of said first ions into said upper energy level manifold; and

a second pumplight aligned to couple energy into said medium at a second wavelength that excites a second portion of said first ions to a third energy level manifold, a fraction of which relax to said upper energy level manifold and thereby increase the total quantity of said first ions at said upper energy level manifold, increasing the energy emitted at said laser wavelength.

2. The laser of Claim 1 wherein said medium is a crystal.

3. The laser of Claim 1 wherein said medium is selected from one of: Sc_2SiO_7; Sc_2SiO_5; Y_2SiO_5; $Ca_2Al_2SiO_7$; $Ca_2Ga_2SiO_5$; YVO_4, $BeAl_2O_4$, and similar materials including glasses.

4. The laser of Claim 1 wherein said medium is yttrium-aluminum-garnet.

5. The laser of Claim 1 wherein said first ions are erbium ions, and wherein said lower energy level manifold is the erbium $^4I_{15/2}$ manifold, said upper energy level manifold is the erbium $^4I_{13/2}$ manifold, and said third energy level manifold is the erbium $^4I_{11/2}$ manifold.

6. The laser of Claim 5 wherein and said first wavelength is near 1540nm, said second wavelength is near 980nm, and said laser wavelength is near 1640nm.

7. The laser of Claim 1 wherein said first pumplight is a light emitting diode array and said second pumplight is a erbium:fiber laser that emits energy at a wavelength near 980 nanometers.

8. The laser of Claim 1, further comprising a Q-switch disposed at an end of said medium through which said emitted laser wavelength light exits said medium.

9. The laser of Claim 1 wherein the energy coupled from said first pumplight and said second pumplight are synchronized in time.

10. The laser of Claim 9 wherein said first pumplight and said second pumplight energy coupling are synchronized such that they do not overlap in time.

11. The laser of Claim 9 wherein said first pumplight couples energy at said first wavelength for approximately four milliseconds, and said second pumplight subsequently couples energy at said second wavelength for approximately two milliseconds.

12. The laser of Claim 1 further comprising second ions doped into said medium and wherein said second wavelength energy indirectly excites said second portion of said first ions by directly exciting a portion of said second ions to an increased energy level manifold that induces an inter-ionic energy transfer to said second portion of said first ions.

13. The laser of Claim 12 wherein said first ions are erbium ions and said second ions are ytterbium ions.

14. The laser of Claim 13 wherein said increased energy level manifold is the ytterbium $^2F_{5/2}$ manifold, said lower energy level manifold is the erbium $^4I_{15/2}$ manifold, said upper energy level manifold is the erbium $^4I_{13/2}$ manifold, and said third energy level manifold is the erbium $^4I_{11/2}$ manifold.

15. The Laser of Claim 13 wherein said first wavelength is near 1540nm, said second wavelength is near 940nm and said laser wavelength is near 1640nm.

16. A laser comprising:

a medium formed from erbium ion doped yttrium-aluminum-garnet that emits laser light near 1640 nanometer wavelength as a result of the transition of electron energy from the erbium ion $^4I_{13/2}$ energy level manifold to the erbium ion $^4I_{15/2}$ energy level manifold;

a diode array pumplight aligned to couple energy near 1540 nanometer wavelength, for a first period of time that is approximately four milliseconds in duration, into said medium and thereby excite a first portion of said erbium ions into the erbium $^4I_{13/2}$ energy level manifold;

an erbium:fiber laser pumplight aligned to couple energy near 980 nanometers, for a subsequent period of time that is approximately two milliseconds in duration, into said medium and thereby excite a second portion of said erbium ions into the erbium ion $^4I_{11/2}$ energy level manifold, a fraction of which relax to the erbium ion $^4I_{13/2}$ energy level manifold and thereby increase the total quantity of said erbium ions at said $^4I_{13/2}$ manifold; and

a Q-switch disposed at an end of said medium through which said emitted laser wavelength light exits said medium.

17. A laser comprising:

a medium formed from erbium ion and ytterbium ion doped yttrium-aluminum-garnet that emits laser light near 1640 nanometer wavelength as a result of the transition of electron energy from the erbium ion $^4I_{13/2}$ energy level manifold to the erbium ion $^4I_{15/2}$ energy level manifold;

a first diode array pumplight aligned to couple energy near 1540 nanometer wavelength, for a first period of time that is approximately four milliseconds in duration, into said medium and thereby excite a first portion of said erbium ions into the erbium $^4I_{13/2}$ energy level manifold;

a second diode array pumplight aligned to couple energy near 940 nanometers, for a subsequent period of time that is approximately two milliseconds in duration, into said

medium and thereby excite a portion of said ytterbium ions into the ytterbium $^2F_{5/2}$ energy level manifold, which induces an inter-ionic energy transfer to the erbium ion $^4I_{11/2}$ manifold, a fraction of which relax to the erbium ion $^4I_{13/2}$ energy level manifold and thereby increase the total quantity of said erbium ions at said $^4I_{13/2}$ manifold; and

a Q-switch disposed at an end of said medium through which said emitted laser wavelength light exits said medium.

18. A method of producing laser light in a laser having a medium doped with first ions that emit light at a laser wavelength as a result of the transition of electron energy from an upper energy level manifold to a lower energy level manifold, and having a first pumplight operable to output energy at a first wavelength, and a second pumplight operable to output energy at a second wavelength, the method comprising the steps of:

coupling energy at the first wavelength from the first pumplight into the medium, thereby exciting a first portion of the first ions into the upper energy level manifold and

coupling energy at the second wavelength from the second pumplight into the medium, thereby exciting a second portion of the first ions to a third energy level manifold, a fraction of which relax to said upper energy level manifold, thereby increasing the total quantity of the first ions at the upper energy level manifold, and increasing the energy emitted at said laser wavelength.

19. The method of Claim 18 wherein the medium is a crystal.

20. The method of Claim 18 wherein the medium is yttrium-aluminum-garnet.

21. The method of Claim 18 wherein the first ions are erbium ions, and wherein the lower energy level manifold is the erbium $^4I_{15/2}$ manifold, the upper energy level manifold is the erbium $^4I_{13/2}$ manifold, and said third energy level manifold is the erbium $^4I_{11/2}$ manifold.

22. The method of Claim 21 wherein the first wavelength is near 1540nm, the second wavelength is near 980nm, and the laser wavelength is near 1640nm.

23. The method of Claim 18 wherein the first pumplight is a light emitting diode array and the second pumplight is an erbium:fiber laser that emits energy at a wavelength near 980 nanometers.

24. The method of Claim 18 wherein the laser further includes a Q-switch disposed at an end of the medium, further comprising the step of emitting the laser light through the Q-switch upon reaching the switching threshold of the Q-switch, thereby emitting a short pulse of laser light.

25. The method of Claim 18, further comprising the step of synchronizing the coupling of energy from the first pumplight and the second pumplight.

26. The method of Claim 25 wherein said synchronizing step is accomplished such that the coupling of the first pumplight energy and the second pumplight energy do not overlap in time.

27. The method of Claim 25 wherein the first pumplight couples energy at the first wavelength for approximately four milliseconds, and the second pumplight subsequently couples energy at the second wavelength for approximately two milliseconds.

28. The method of Claim 18 wherein second ions are doped into the medium, further comprising the step of indirectly exciting the second portion of the first ions by directly exciting a portion of the second ions to an increased energy level manifold that induces an inter-ionic energy transfer to the second portion of the first ions.

29. The method of Claim 28 wherein the first ions are erbium ions and the second ions are ytterbium ions.

30. The method of Claim 29 wherein the increased energy level manifold is the ytterbium $^2F_{5/2}$ manifold, the lower energy level manifold is the erbium $^4I_{15/2}$ manifold,

the upper energy level manifold is the erbium $^4I_{13/2}$ manifold, and the third energy level manifold is the erbium $^4I_{11/2}$ manifold.

31. The method of Claim 29 wherein the first wavelength is near 1540nm, the second wavelength is near 940nm and the laser wavelength is near 1640nm.